Preserving Our Highways & Bridges

A strategic approach to manage our highways effectively and efficiently, and to maximize the life of Wisconsin's highway system.

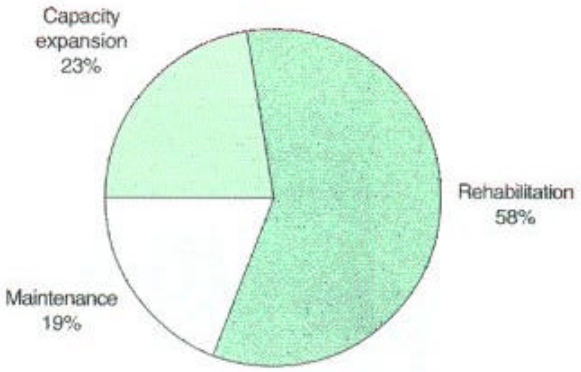
Taking care of our highways and bridges

To ensure a quality future for our highways and bridges, we must make careful investments to apply the right fix, in the right place, at the right time.

Highways are a valuable asset to Wisconsin's economy and quality of life, and represent a major investment in public infrastructure. In 1997, Wisconsin spent nearly $720 million to build and maintain the State Trunk Highway (STH) System. Most spending was not for new highways; instead, 77% of all expenses were for maintenance or rehabilitation of the existing system.

Wisconsin has worked hard to build this highway system that supports our economy and quality of life. The system must be maintained through an effective investment management strategy that applies the right fix, in the right place, at the right time.

1997 State Highway Expenditures



The State Highway System is the core of our transportation network...

The STH System includes over 11,800 miles of two-lane and multi-lane highways. The System includes all Interstate, US, and State Highways, and over 4,600 bridges. Separate from the STH System are the nearly 100,000 miles of county, municipal or town roads. The STH System accounts for just 11% of roadway mileage in the state, but carries 60% of all traffic.

...and the backbone of our economy.

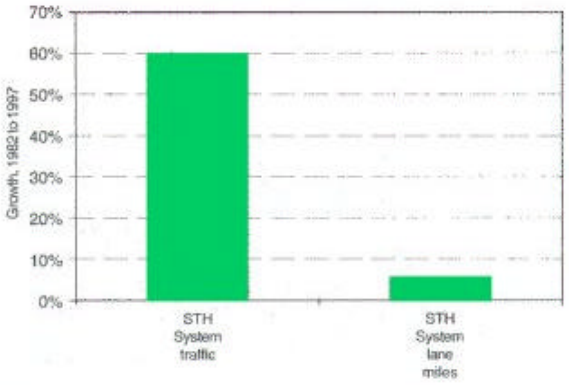
The STH System includes the 3,650 mile Corridors 2020 system, the busiest and most economically important highways in the state. From 1990 to 1996, 87% of new or expanding Wisconsin businesses located in communities within 5 miles of a Corridors 2020 route, underscoring the relationship between quality highways and economic development.

Trade magazines surveys and testimonials of firms that have chosen to locate in the state consistently highlight the importance of good transportation as a key factor in economic development.

Meeting present and future challenges

What are the challenges? Traffic has increased dramatically...

Traffic growth on the STH System has increased greatly in recent years. From 1982 to 1997, total vehicle-miles of travel on the STH System increased by 60%, but the number of STH System lane miles increased by only 5%.



The growing amount of traffic, especially truck traffic, has caused greater pavement wear. By the year 2000, about 30% of STH System roadways will need improvement to sustain acceptable pavement conditions.

...while highways and bridges are aging...

Much of the STH System -- including the Milwaukee freeway system -- was constructed in the 1950's and 1960's. In fact, over half of all bridges on the STH System are over 30 years old, and almost one quarter of all bridges are over 40 years old. Even if the visible surface has been treated in recent years, the underlying foundation of highways and bridges may have been built decades ago.

The average life span for pavements is about 50 to 60 years, and the life span for bridges is 70 to 100 years (depending on the type of bridge). If highways and bridges age beyond their appropriate life span, then the system will require costly, frequent, and very inconvenient work simply to maintain highways at a basic level of quality.

...resulting in significant needs on the system.

As the system ages, and as traffic continues to increase, the percentage of poor quality pavements could increase if not countered with a systematic strategy to address needs. WisDOT is constantly working to reduce the number of low-quality pavements and bridges to ensure the safety, comfort and convenience of motorists.

Building highways

How is a road built?

Most people use roads every day without a second thought as to how they are built, what materials are used, or what kind of structure is in place. Drivers simply assume that pavements will provide a smooth and safe ride for all vehicles -- whether a compact car or a 40-ton truck.

Start with the underlying layers...

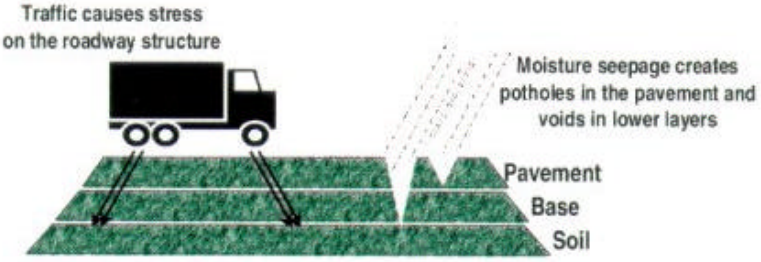
Wisconsin highways are typically comprised of three layers: soil, base, and pavement. The top two layers carry and distribute vehicle loads to the underlying soil layer. The base is made up of a sand and gravel aggregate. An additional subbase provides stability if the soil contains a large amount of clay or is saturated with water.

...then add concrete or asphalt pavement.

WisDOT primarily uses two types of pavement surface materials, either a Portland Cement Concrete (PCC) or an asphaltic concrete (AC, or "blacktop"). Asphalt provides a flexible material that rebounds as vehicles travel on the surface. PCC pavements are designed to be rigid and hold their structure under traffic.

Deterioration can occur in all layers.

Over time, highways deteriorate due to heat expansion, thawing and refreezing, wear from heavy vehicles, and water seepage. Deterioration of the pavement surface will cause ruts, cracks, potholes, and other deformities that lead to a rough ride. Water may also seep down and create weakness in the base and soil layers. This leads to further instability, as the surface may become unsupported in places.



Maintaining highways

Building a road is just the first step in a lifetime of continuous management of a highway. WisDOT uses three broad categories of treatments to maintain quality on the STH System:

Maintenance fixes immediate problems.

Deterioration of the surface pavement can be fixed through ongoing maintenance, such as patching potholes or filling cracks. However, while the surface is now structurally sound and relatively smooth, deterioration in the underlying base and soil layers is not addressed.

Rehabilitation provides a new surface.

Eventually, the entire pavement deteriorates and continual surface maintenance yields diminishing results. Rehabilitation (which includes resurfacing and limited base improvements) provides a new asphalt or concrete surface on top of the existing layers. Again, though, most problems in the underlying base and soil layers are not addressed.

Reconstruction renews the highway.

Over a 50 to 60 year period, a highway undergoes continual maintenance work, and receives two surface rehabilitations. During this time, though, the underlying layers have continued to deteriorate and cannot support another surface overlay. A total reconstruction is now required to completely renew the highway facility.

During reconstruction (and, in limited cases, during rehabilitation), other improvements can be made to a roadway. Safety improvements may include straightening curves, flattening hills, or adding passing lanes. A project may also modernize interchanges. Other possible enhancements could include new street lights in downtown areas or special landscaping along the highway right-of-way.

The life-cycle of a highway

NEW ROAD

A new roadway needs no improvement for several years after initial construction

MAINTENANCE

In years 5-15, MAINTENANCE fixes basic surface problems and helps prevent deterioration

15 years

REHABILITATION

At 15-20 years, REHABILITATION provides a new surface layer, but underlying layers are not treated

MAINTENANCE

In years 20-35, MAINTENANCE again fixes surface problems, but underlying layers deteriorate

30 years

REHABILITATION

At 35-40 years, another REHABILITATION provides a new surface, but underlying layers are not treated

45 years

MAINTENANCE

In years 40-55, MAINTENANCE again fixes the surface, but underlying layers deteriorate

RECONSTRUCTION

60 years

By years 55-60, a complete RECONSTRUCTION is needed to renew the roadway structure

The life cycle strategy: the right fix, in the right place, at the right time

The life-cycle strategy provides a cost-efficient, effective approach to managing our highway needs, and maximizes the life of the STH System.

WisDOT weaves the three basic elements of highway improvements -- maintenance, rehabilitation, and reconstruction -- into a life-cycle strategy that preserves a highway over 50-60 years. The process includes ongoing maintenance activities, periodic surface rehabilitation, and a final reconstruction that renews the highway and restarts the cycle. The life-cycle forms a systematic, objective approach to maximize the effectiveness and long-term efficiency of those improvements.

Why use the life-cycle strategy? What are the benefits?

The life-cycle strategy applies the right fix, in the right place, at the right time. It does not necessarily provide the improvement with the least initial cost. However, it does provide the most efficient and appropriate option when balancing the preservation needs of the highway, the need to minimize motorist delay, and the desire to maintain safe, convenient and comfortable roadways.

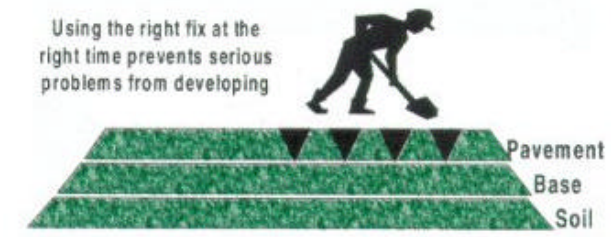
- WisDOT's life-cycle strategy results in fewer construction projects over the life of a highway by using more thorough but less frequent improvement projects. In contrast, a maintenance-only process without rehabilitation or reconstruction results in frequent projects that yield little long-term value.

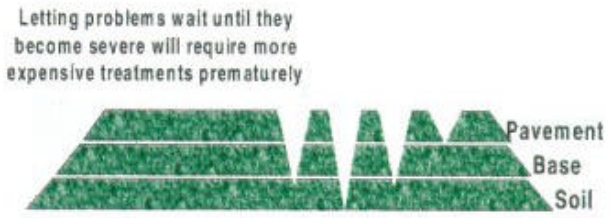
- The life-cycle approach provides consistently smooth and safe pavement surfaces throughout a highway's life. At the end of a life cycle, reconstruction provides a solid foundation for a good pavement structure.

- The life-cycle strategy is the most cost effective long-term method to manage highways. The life-cycle addresses immediate surface problems (maintenance), it provides effective interim solutions (rehabilitation), and it provides renewal at the end of the roadway life (reconstruction).

Waiting for problems to become severe before fixing is not cost-effective.

WisDOT's strategy applies timely, appropriate fixes to pavement problems before they become severe and create even more costly problems. For example, if surface maintenance or rehabilitation is delayed, it could lead to greater degradation of the base and soil layers, thus requiring a complete reconstruction far earlier than should have been necessary. The life-cycle strategy provides an effective balance between minimizing total investment cost and maximizing pavement life span.





Basic bridge structures

WisDOT is responsible for building and maintaining over 4,600 bridges on the STH System. Bridges are used to pass over any number of features: streets, railroads, waterways, wetlands, or uneven terrain. WisDOT maintains all bridges that cross or are part of the STH System, even if the bridge itself carries a local road or railroad on its surface. Almost 35% of all bridges in the state are maintained by WisDOT.

Box culverts are virtually invisible...

There are two primary types of bridges on the STH System. Box culvert bridges are reinforced concrete frames commonly used to carry water under a roadway, or to provide pedestrian or animal access under roadways. The more than 500 box culverts on the STH System are virtually invisible to motorists, because they are actually underneath the highway layers.

...while general bridges are more common.

General bridges are the most common type in Wisconsin, with about 3,200 bridges on the STH System. A general bridge has two primary components: a substructure of piers, walls and abutments that support the deck; and a superstructure of the deck that supports the riding surface.

There are also about 900 other bridges on the STH System of various types including arch-type, box girders, and lift bridges. However, the vast majority of STH System bridges are box culvert or general bridges.

Bridges are a key element of freeways.

Bridges play an important role in the design of freeways, especially in urban areas. Freeway bridges allow for free-flow access on the highway, while allowing for continuity of the local street or county road systems. Bridges play a key role in freeway interchanges, with well-designed networks of ramps and overpasses providing free-flow access in several directions.

Maintaining and improving bridges

Just as with highway pavements, WisDOT uses a life-cycle strategy to preserve general bridges by providing the right fix, in the right place, at the right time.

Bridge maintenance fixes problems and prolongs the bridge life.

As with highways, the riding decks of bridges may need occasional maintenance to fix immediate surface problems such as cracking or potholes. Maintenance activities such as painting and cleaning can also extend the life of both the superstructure and the substructure.

A deck overlay provides a new surface.

Similar to highways, bridge deck maintenance can only be performed for 15-20 years before the riding surface deteriorates and provides a rough ride. At this point, an overlay is needed to provide a new riding surface. A deck overlay usually requires only a short construction period.

Deck replacement provides a new surface that can be supported by the existing structures.

After another 15-20 years of deck maintenance, it is again time for improvements to the riding surface. However, the original bridge deck may be unable to handle the weight of another overlay, and so a complete deck replacement is necessary. Complete deck replacement is a longer project that will likely result in bridge closure for several weeks.

Complete reconstruction renews the bridge.

Over time, the bridge deck surface has been maintained and overlaid, but other parts of both the superstructure and substructure may deteriorate. After 70-75 years, a complete reconstruction of the bridge will likely be needed to replace all elements of the bridge. This requires an even longer construction period, but it does provide the opportunity to perform realignment or make other structural changes to the bridge design and layout.

Box culvert structures are replaced at 100 years.

Box culvert structures are designed to last for about 100 years, at which time they will need complete replacement. A box culvert is actually buried underneath a regular pavement surface, which is maintained through the pavement life-cycle strategy.

The life-cycle of a general bridge

NEW BRIDGE

A new bridge needs no improvement for several years after initial construction

20 years

DECK OVERLAY

At 15-20 years, a new pavement is overlaid on the bridge deck to provide a smooth surface and ensure proper water drainage.

40 years

DECK REPLACEMENT

At 35-40years, the aging deck cannot support a new overlay, so the entire deck is replaced.

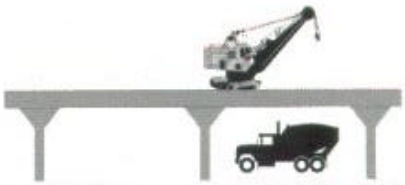
60 years

DECK OVERLAY

At 55-60 years, a new pavement is overlaid on the bridge deck to provide a smooth surface and ensure proper water drainage.

80 years

RECONSTRUCTION



By years 70-75, a complete RECONSTRUCTION may be needed to renew both the deck and the supporting structures.

Monitoring highway and bridge quality

Not every highway or bridge will experience exactly the same life span. The life spans laid out in this document are estimates, and can be extended or shortened based on a number of factors. That is why WisDOT's life-cycle strategies are managed only in part by the ages of structures, and are also driven by systematic criteria that identify needs and prescribe appropriate treatments.

Pavements are measured for ride quality and distress.

WisDOT evaluates the general quality of pavements every year on Interstate highways, and every two years on the rest of the STH System (maintenance problems such as potholes and cracks are identified and fixed on an ongoing basis). WisDOT uses two measures to evaluate pavements:

- The Pavement Distress Index measures the structural adequacy of the pavements, including rutting, cracking, surface distortion, and weakness in the base and soil layers.

- The Pavement Serviceability Index measures ride quality and pavement roughness.

Bridges are evaluated for structural deficiencies and deck condition.

All STH System bridges are inspected for two measures:

- A Rate Score measures the quality of a bridge's superstructure, substructure, and load-carrying capacity. Lower rate scores reflect problems such as cracks, rust, susceptibility to flooding, load factors, traffic levels, bridge clearances, and bridge width.

- The Deck Condition evaluates the riding surface and other deck components. Lower deck condition scores will indicate a need for ongoing maintenance, and at some point full deck rehabilitation.

Computer models help predict future needs.

WisDOT uses predictive computer models to combine various quality measures and determine alternative options to improve highways. The models identify highways that will have future needs, and evaluate different treatment options based on cost, value and life expectancy. These models provide objective, data-driven tools to help make choices on how to manage quality on the STH System.

Research evaluates new materials and innovative construction methods.

WisDOT is constantly researching new pavement and bridge materials and improvement methods to further increase highway life and improve cost-effectiveness. Recent studies have evaluated high performance concrete materials, various mixes of AC surfaces, the use of reinforcing dowel bars in PCC pavements, different practices of joint construction and crack sealing for AC pavements, and use of recycled waste materials in a highway base layer.

How can I get involved?

Even after reading this booklet, you still may not pay attention to highway and bridge quality every day, and that's fine. However, we ask that you do take an interest when a highway improvement project affects you or your community.

Ask questions about the kind of improvement being considered, and how it will improve the quality of our transportation system. Attend public meetings, and watch for announcements from a WisDOT District Office regarding new projects. Then work with your neighbors, local business owners, and community leaders to discuss the project and its importance.

For additional copies of this document, or for comments, questions, or other requests, contact:

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